Photon Multiplicity at Forward Rapidity at RHIC

Sunil M. Dogra (for STAR collaboration)
University of Jammu

Outline:

Motivation

Photon Multiplicity Detector

Results

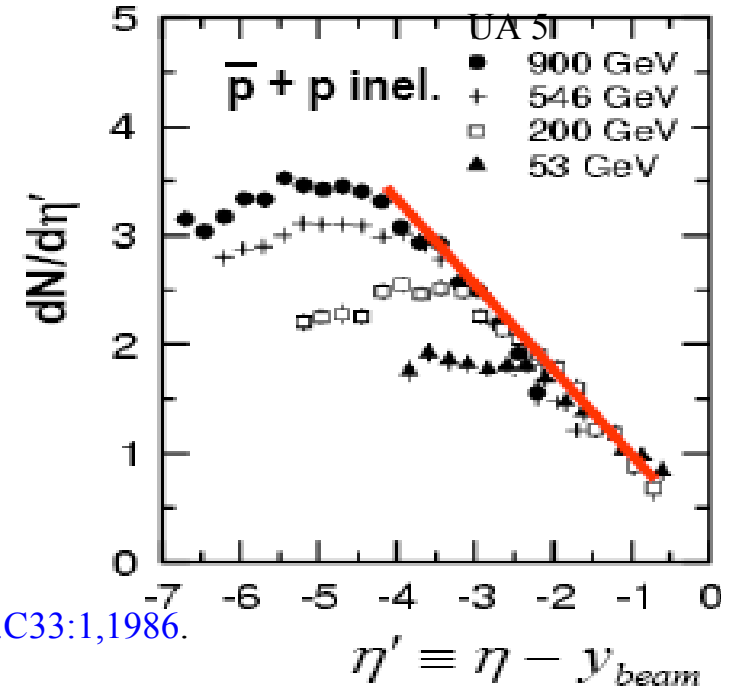
Conclusions

Motivation

- Particle Production Mechanism:
  - Measure photon multiplicity and pseudorapidity distribution in the heavy ion collisions and compare to various particle production models.
- Longitudinal Scaling in Heavy Ion Collision
  - Energy, System Size dependence

$$\eta = -\ln \tan(\theta / 2)$$

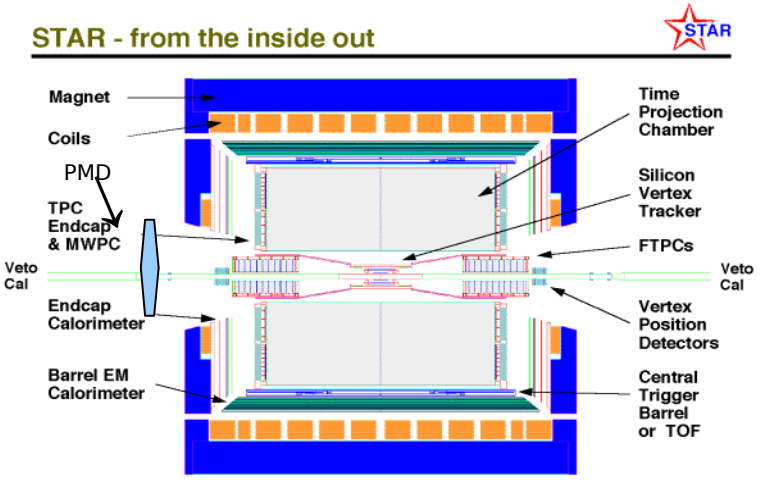
$$y_{beam} = \ln(\sqrt{s}) / m$$

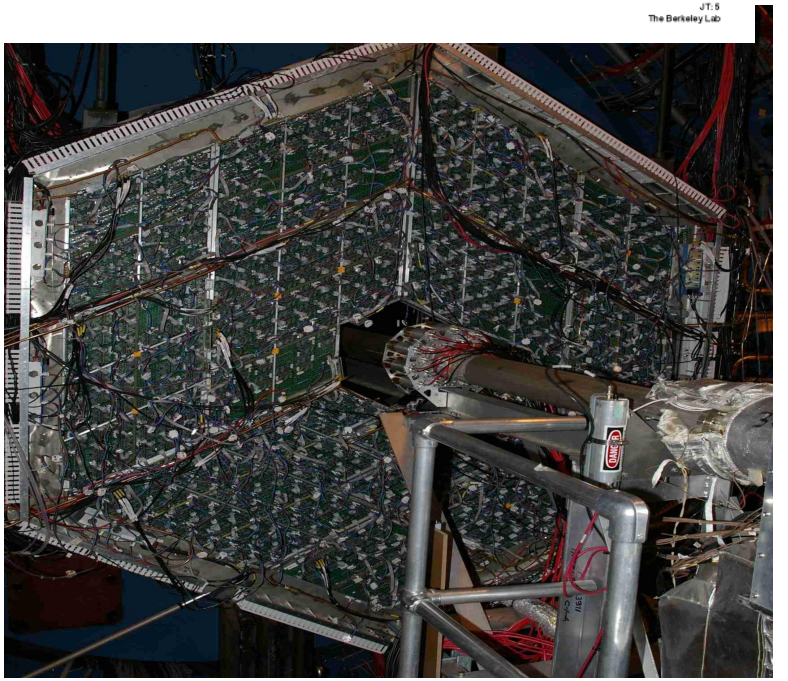


G.J. Alner et al. UA5 Collaboration Z.Phys.C33:1,1986.

STAR Photon Multiplicity Detector (PMD)

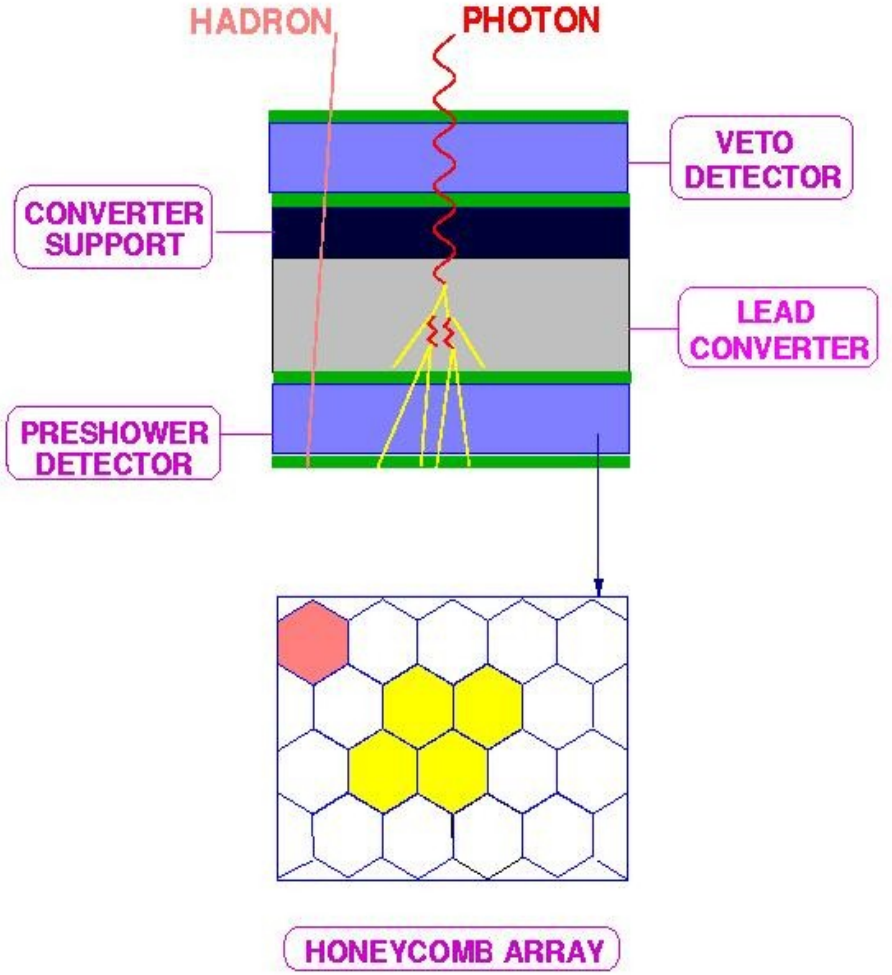
- Two planes CPV+Preshower
- Gas detector of hexagonal cells
- Cell cross section : 1.0 cm^2
- Cell depth : 0.8 cm
- Gas used: Ar+CO_2 in 70:30
- Total number of cells : 82,944
- Area of the detector : 4.2 m^2
- Distance from vertex : 540 cm
- Coverage: -2.3 to -3.8 in η with full ϕ





Principle of Photon Multiplicity Detector

Photons passing through the converter initiate an electro-magnetic shower and produce large signal on several cells of the sensitive volume of the detector. Hadrons normally affect only one cell and produce a signal representing minimum ionizing particles.



Analysis Details

STEP-1: Read the raw data

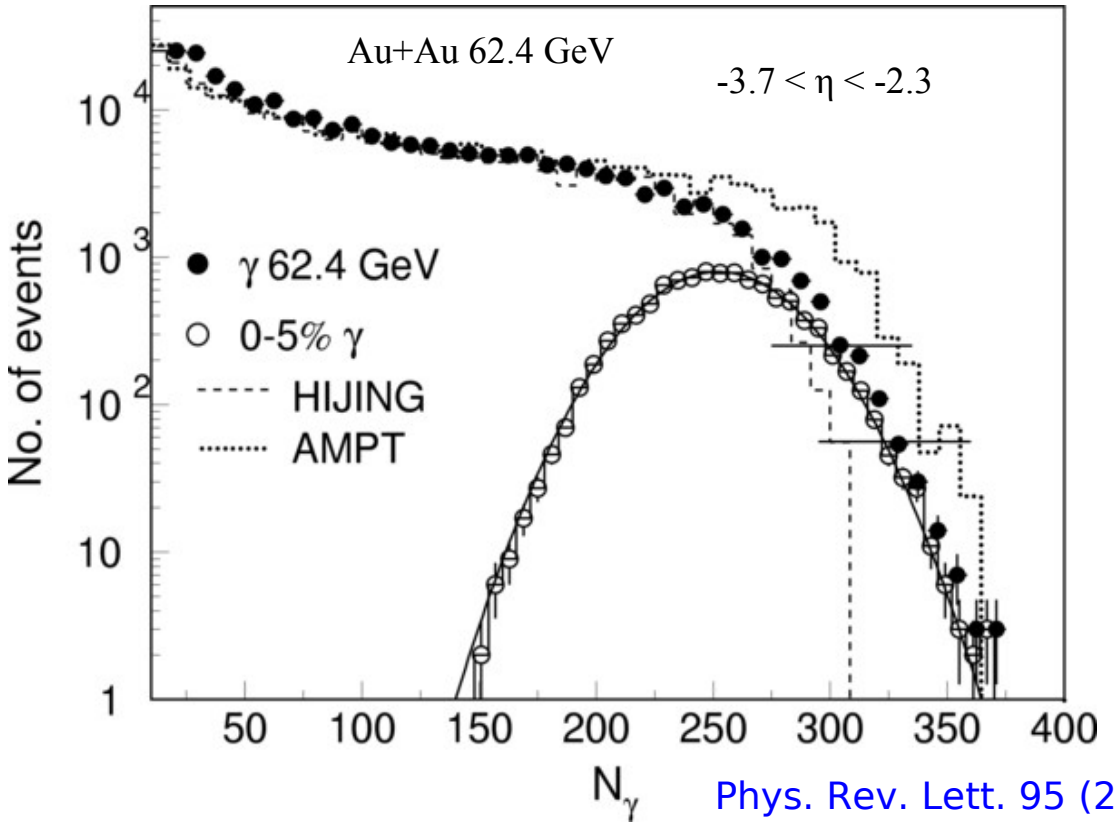
STEP-2: Data Cleanup

STEP-3: Cell to Cell Gain Calibration

STEP-4: Clustering of Hits

STEP-5: Photon-hadron Discrimination by applying cuts on Edep and Ncell

Multiplicity Distribution

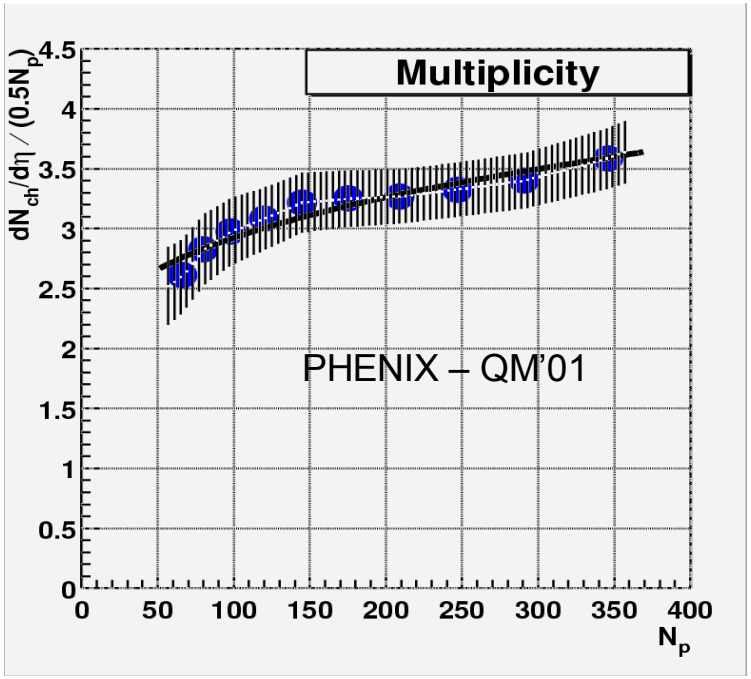


Phys. Rev. Lett. 95 (2005) 062301

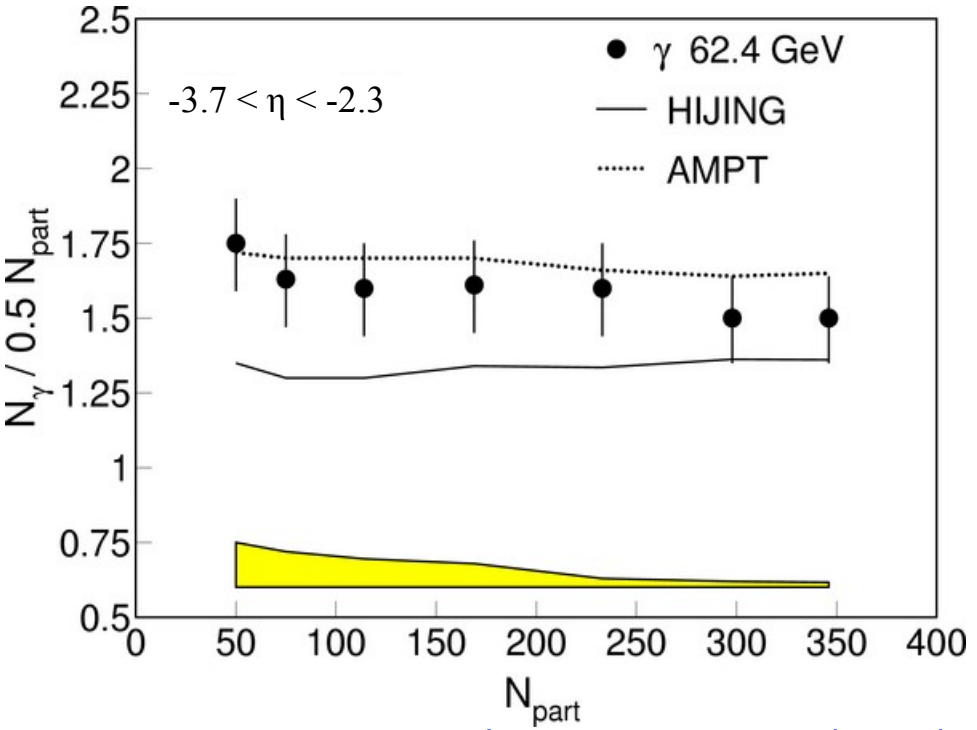
HIJING under predicts the data for central collisions
AMPT over predicts the data for central collisions

Particle Production per participating nucleon pair

PHENIX
Charge particles at Mid rapidity



STAR
Photons at Forward rapidity



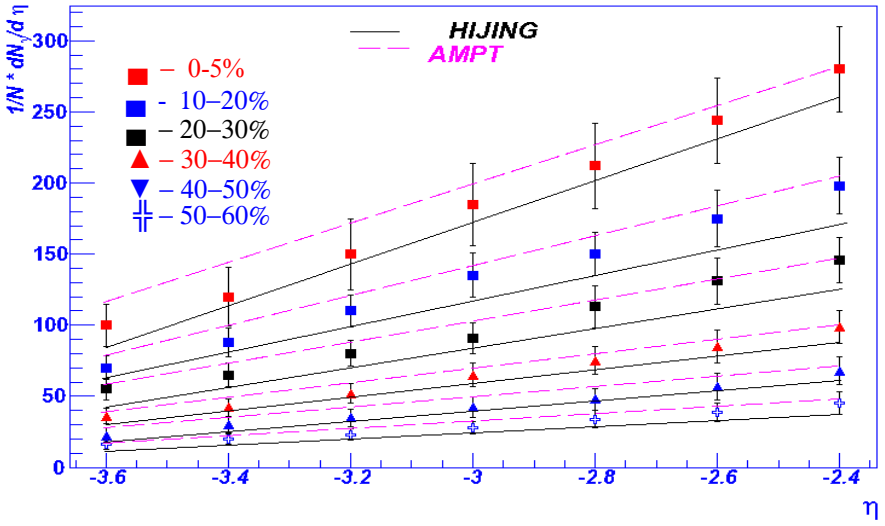
Phys. Rev. Lett. 95 (2005) 062301

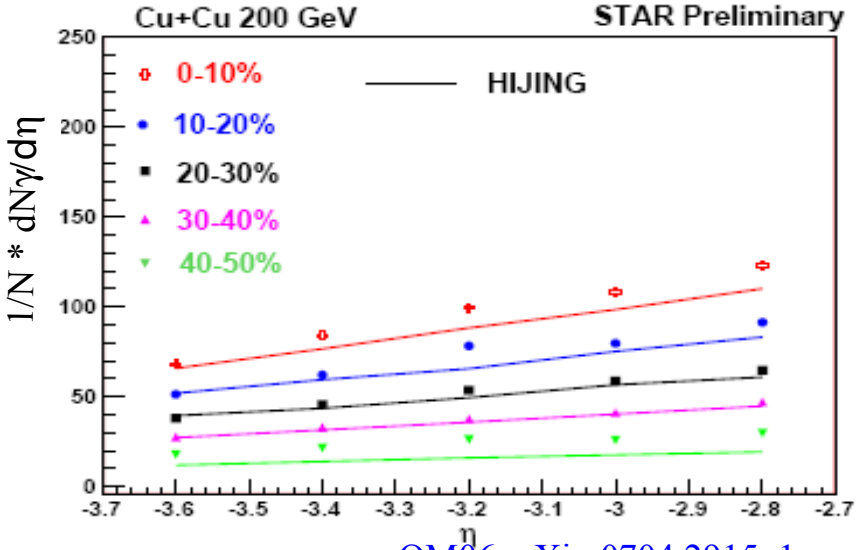
Charge particles multiplicity at mid rapidity does not scale with N_{part} indicates contribution from hard process
Photon multiplicity scales with N_{part} at forward rapidity

Pseudorapidity Distributions of Photons

STAR : Phys. Rev. Lett. 95 (2005) 062301

Au+Au 62.6 GeV

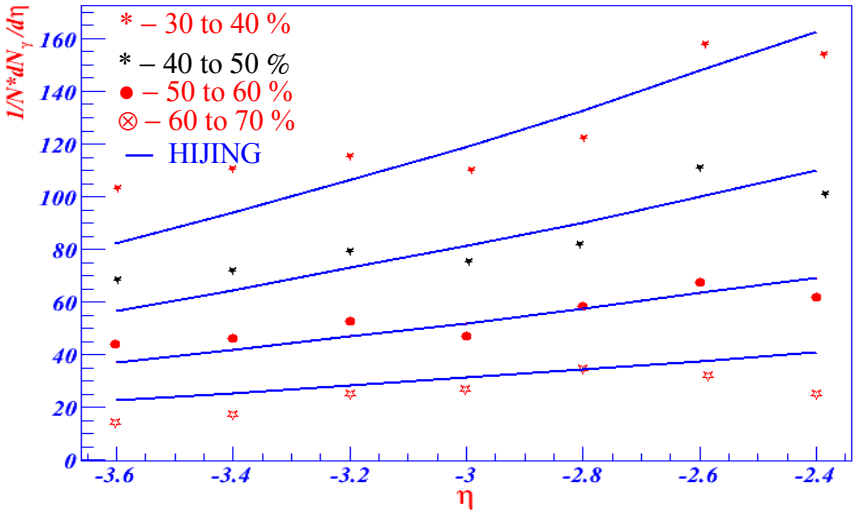


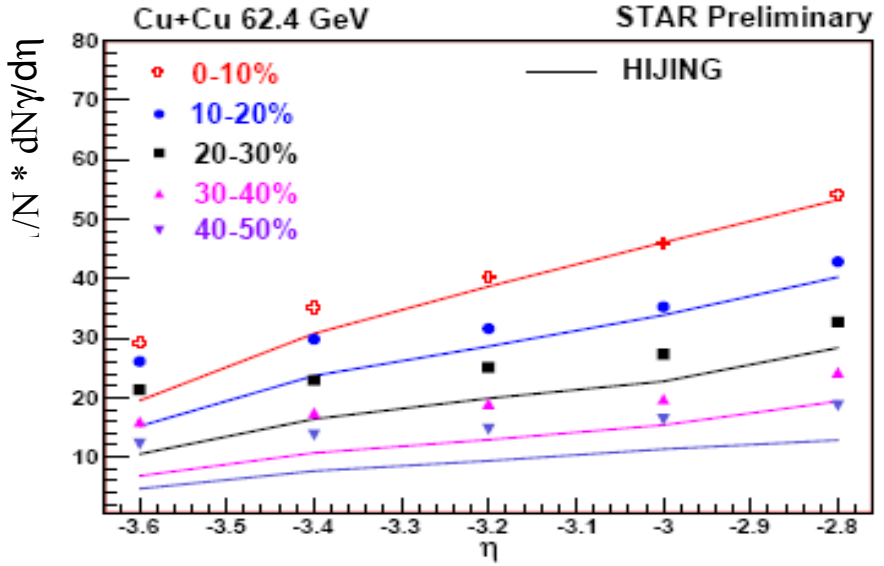


QM06 arXiv:0704.2915v1

Monika Sharma, Sunil Dogra, Neeraj Gupta for STAR Coll.

Au+Au 200 GeV STAR Preliminary





$dN_\gamma / d\eta$ of photons for various systems and energies

Also the HIJING under predicts the data and

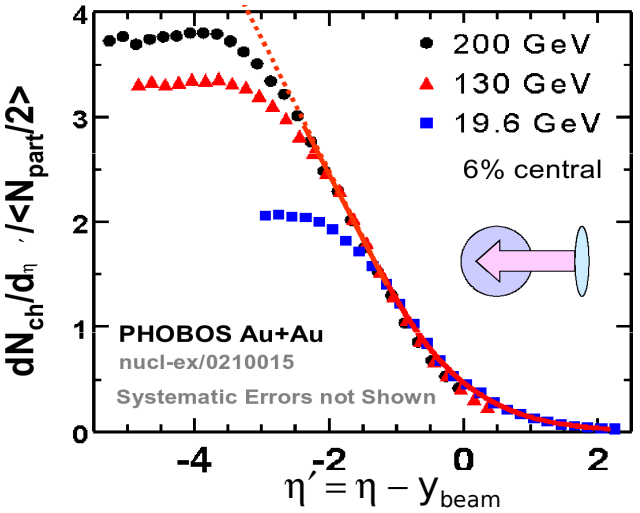
AMPT for 62.4 GeV over predicts the data

QM06 arXiv:0704.2915v1

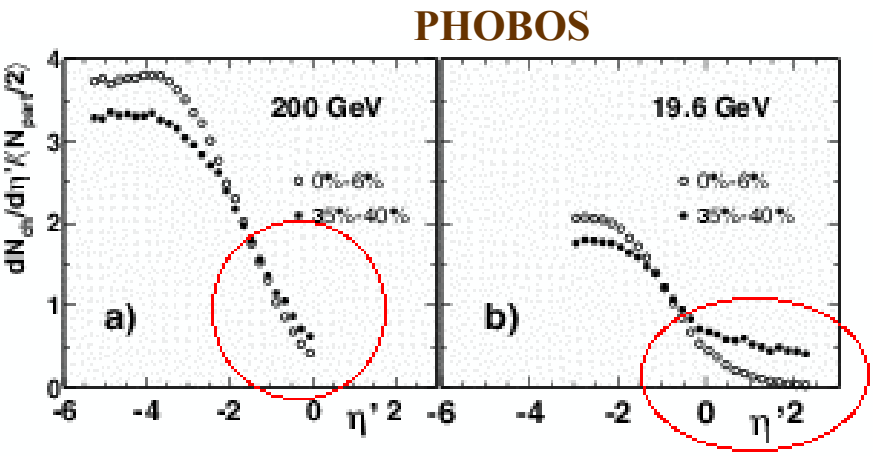
Monika Sharma, Sunil Dogra, Neeraj Gupta for STAR Coll.

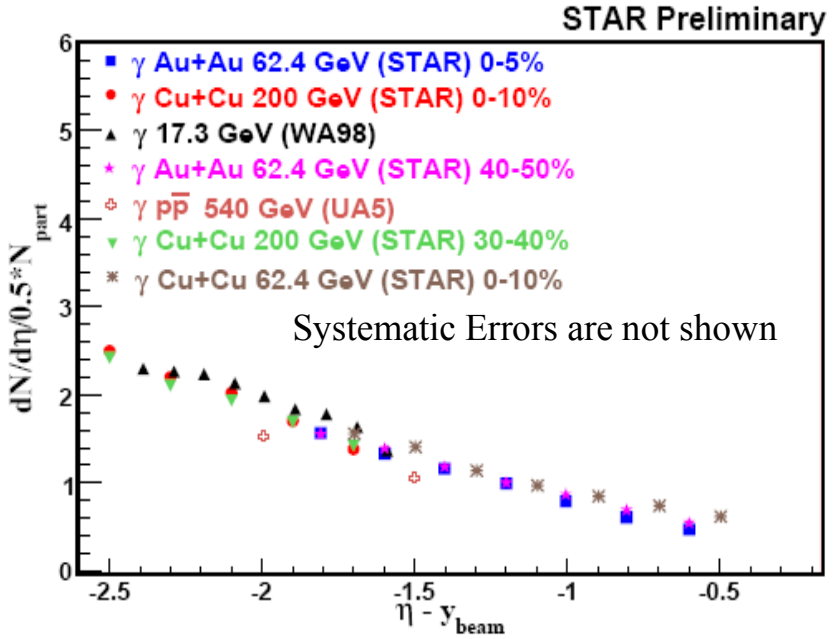
Longitudinal scaling

N_{ch}: Energy independent Longitudinal Scaling



N_{ch} : Centralilty dependent Longitudinal Scaling





Main source π^0
Other sources are ω, K^0, η

QM06 arXiv:0704.2915v1
Monika Sharma, Sunil Dogra, Neeraj Gupta for STAR Coll.

Photon production follows Energy and Centrality independent longitudinal scaling

Summary

- $dN_\gamma/d\eta$ for various systems with centralities were presented.

  Also the shapes of the pseudorapidity distributions in Au + Au and Cu+Cu at different energies were similar and they differ only by a overall factor.

- Photon production at forward rapidity scales with number of participating nucleons.

- Photon production follows energy and centrality independent longitudinal scaling.

Outlook

- Azimuthal Anisotropy in photon production(elliptic flow).
- Multiplicity Fluctuation(for a thermodynamic system related to compressibility.
- N_γ/N_{ch} fluctuations to look for disoriented chiral condensates (N_{ch} from Forward Time Projection Chamber)

Thank you